TUTORIALS Bob Palmer

Files are in
http://pubweb.bnl.gov/people/palmer/04school/icool2/
and in compressed form in
http://pubweb.bnl.gov/people/palmer/04school/icool2z/ make a new comand line directory and copy all these files into it.

These files include an icool executable, a basic compiler, a topdraw plotter.

You may later want to use your own compilers and plotters, but this way we can hopefully get instant results.

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Try typing any of the following: any one should execute and give a plot on the screen
page down should show more plots

- runtrack focus
- runtrack focus0
- runtrack focus1
- runtrack focus2
- runbeta fs2
- runlong cont (but not yet)
- runring ring (nor this yet)

Introduction

All our ICOOL jobs read files: for001.dat (data) and for003.dat (input tracks) , and for020.dat (coild desciption) or for045.dat (field description).

They will write for002.dat (a log file) and and for009.dat (an ntuple) among others.

I have short basic programs to read the ntuple and generate top draw plot files: ###.td which can be converted into tex files for printing.

To keep track of these files when running different jobs, it is convenient to save them with a job name that I will write as ###. The files are then kept with names:###.coi ###.f01, ###.f03 etc

Main data file: ###.f01

###.f01 copied to for001.dat main data used by icool
a very simple case "focus.f01" contains:

```
 Drift space example                          ! a title
 $cont npart=1                                ! no of tracks =1
 nprnt=3 prlevel=1 bgen=.false. $
 $ints $
 $nhs  $
 $nsc  $
 $nzh nzhist=0  $                             ! no of crude plots vs z
 $nrh  $
 $nem  $
 $ncv  $
SECTION
REPEAT                                        ! repeat till "ENDREPEAT"
150                                           ! 150 times
OUTPUT                                        ! write out data to for009.dat
SREGION                                       ! start an 8 line "region"
0.05   1  0.001                               ! deltaz 1 zstep   (m)
1  0.  0.10                                   ! 1 0 rmax
SOL                                           ! solenoid
1 0 0 0. 1.8 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.    ! 1 0 0 0 Bz 0 0 0 0 0 0 0 0 0 0
VAC                                           ! no material, could be CU, BE etc
CBLOCK                                        ! dummy material shape
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.            ! dummy material shape

ENDREPEAT                                     ! end repeat

ENDSECTION                                    ! end of run
```

Input tracks file: ###.f03

###.f03 copied to for003.dat initial tracks used by icool
this example (focus.f03) has only two tracks. Add one line each for more.

```
focus                                          ! title
0  0  0  0  0  0  0  0                         ! used for restarting, ignore here
1 0 2 0 0 1 0 0 0 .005 .005 .2 0 0 1           !i 0 mu 0 t wt x y z px py pz Px Py Pz
2 0 2 0 0 1 0 0 0 .01  .01  .2 0 0 1           !i 0 mu 0 t wt x y z px py pz Px Py Pz
```

lengths in m, momenta in GeV/c, t in seconds. P's are polarization

Coil File ###.coi

In this case the field is defined in the ###.f01 file so the coil file is ignored

Command to Run Program

Type: "runtrack ###" e.g. "runtrack focus"

this executes the following batch job (runtrack.bat)

```
copy %1.f01 for001.dat      copy main data file
copy %1.f03 for003.dat      copy input tracks
copy %1.coi dirty.dat       copy coil definitions
cleaning      remove comments after !'s
copy clean.dat coil.dat      copy cleaned up coil file
sheet3      Make multiple current sheets for coil blocks
copy sheet.out for020.dat      copy sheet data
icool      Run ICOOL
TRACK2      Run analysis of ntuple file to make plots
copy coil.td + track.td %1.td  Copy plot files
VU %1.td      Vue plots with TOPDRAW
```

Log file: FOR002.dat

for002.dat log written by icool which lists of regions, error messages, and crude plots (I do not use these)

Ntuple output file: FOR009.dat

written by the "OUTPUT" commands in the for001.dat data file
The first line hs a title, the second units, then the track data. e.g.

```
# Drift space example                          ! title
#  units = [s] [m]  [GeV/c] [T] [V/m]          ! units
  i par typ flg reg t x y z Px
```

A Usefull line command: new ##1 ##2

copy the "set" of files to a new name prior to making modifications
e.g. use: "new focus2 newf1"
names may not be more than 8 characters

```
COPY %1.F01 %2.F01
COPY %1.F03 %2.F03
COPY %1.F45 %2.F45
copy %1.coi %2.coi
```

###.f01 Example with coil Specified

```
 focus1                                  ! title
 $cont npart=1                           ! number of particles to track
 nprnt=3 prlevel=1 bgen=.false. $        !
 $ints $                                 !
 $nhs  $                                 !
 $nsc  $                                 !
 $nzh nzhist=0  $                        ! no of crude plots vs z
 $nsc  $                                 !
 $nzh  $                                 !
 $nrh  $                                 !
 $nem  $                                 !
 $ncv  $                                 !
SECTION                                  ! start
CELL                                     ! cell over which sheet fields apply
1                                        ! number of identical cells
.true.


SHEET                                    ! fields from sheets in for020.dat
3 20 .0025 .0025 6 0.24 99 1 0 0 0 0 0 0 0 ! mode file dl dr l r reach interp


REPEAT                                   ! repeat following regions
120                                      ! 120 times
OUTPUT                                   ! print ntpl here
SREGION                                  ! a region has 8 lines
0.05   1  0.001                          ! deltaz 1 zstep
1  0.  0.24                              ! 1 0 rmax
NONE                                     ! dummy for RF or other field
  0. 0. 0 0 0 0 0 0 0 0 0 0 0 0 0 0      !
VAC                                      ! vacuum
CBLOCK                                   ! dummy for shape of material
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.
ENDREPEAT                                ! end repeat loop
ENDCELL                                  ! end cell
ENDSECTION                               ! end of everything
```

Coil Definitions ###.coi

for020.dat coil sheets used by icool is generated by basic prog SHEET3 using coil descriptions in ###.coi

e.g. focus2.coi

```
alternating strong sols new
0 1  1. 1. 1 -.001  10    !zstart nrepeat zfac rfac Ifac z1 z2
2   .25  300000  .5  1 .05 3        !gap r1 I len 1 dr nsheets
.5   .25  -200000  .5  1 .03 3        !gap r1 I len 1 dr nsheets
0 0 0 0 0 0 0                      !end data on coils
0 1 1 1 1                          !zstart nrepeat zfac rfac Ifac
0 0 0 0                            !end data on picture
```

which generates the following "for020.dat" format and a topdraw picture in "coil.td"

```
alternating strong sols new
 6  1
 1  2  .5  .2583333  600000
 2  2  .5  .275  600000
 3  2  .5  .2916667  600000
 4  3  .5  .255 -400000
 5  3  .5  .265 -400000
 6  3  .5  .275 -400000
```

in this case 3 sheets for each coil specified in the .coi

An example with material for cooling: cont.f01

```
C1 Continuous cooling
 $cont npart=100 nsections=1 timelim=500. bgen=.false.
 varstep=.true. nprnt=1 prlevel=-1 epsstep=1e-4 ntuple=.false.
 phasemodel=3 neighbor=.false. dectrk=.true.
 fsav=.false. izfile=1160  bunchcut=1. spin=.true. output1=.true.
 timelim=9999 $
 $bmt nbeamtyp=1 $
1 3 1. 1                                          ! 2ndary pion---not used because bgen=false above
0.     0.0      0.179      0.      0.      0.200  !mean: x y z px py pz
0.     0.       0.         0.0   0.0   0.         !sigs
0
 $ints ldecay=.true.  declev=1            !details of scattering and straggling  - see manual
ldedx=.true. lstrag=.true. lscatter=.true.
  delev=2 straglev=4 scatlev=4  $
 $nhs  $                                  !
 $nsc  $                                  !
 $nzh nzhist=0  $                         ! no of crude plots vs z
 $nsc  $                                  !
 $nzh  $                                  !
 $nrh  $                                  !
 $nem  $                                  !
 $ncv  $
SECTION
REFP
2   .2   0.   0  3                          !muon  reference-momentum   0 0 3
BEGS
CELL
50                                        ! number of following cells
.true.                                    ! alternating signs of Bz in each cell

SHEET            !  ======================== cool t53
3.  20  0.01  0.01  2.80  0.4  10.      2. 99. 0.  0. 0. 0. 0. 0.
SREGION         ! 1/2 HYDROGEN
0.175      1    3e-3
1  0.  0.18
NONE
```

```
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
LH
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

SREGION         !  Hydrogen window
0.0025      1    2e-3
1  0.   0.5
NONE
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
AL
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

SREGION         ! 1st  free
0.2575      1    2e-3
1  0.   0.5
NONE
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
VAC
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

REPEAT
3
SREGION         !RF
0.470  1    5e-3
1  0.   0.65
ACCEL
2.  201.25   15.48  29.80  0.   0. 0. 0. 0. 0.   0. 0. 0. 0. 0. ! mode freq
VAC
NONE
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

ENDR

SREGION         ! RF 4
0.47  1    5e-3
```

```
1  0.   0.65
ACCEL
2.  201.25   15.48  29.80  0.   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.
VAC
NONE
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

SREGION         !  free
0.2575       1  2e-3
1  0.    0.5
NONE
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
VAC
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

SREGION         !  Hydrogen window
0.0025      1    2e-3
1  0.   0.5
NONE
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0.  0. 0. 0. 0. 0.
AL
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.

OUTPUT
SREGION         ! 2nd 1/2 absorber
0.175      1    3e-3
1  0.  0.18
NONE
  0. 0. 0. 0. 0.   0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
LH
CBLOCK
   0. 0. 0. 0. 0.   0. 0. 0. 0. 0.
ENDCELL
ENDSECTION
```

Description of Jobs

1. runtrack focus fixed field
2. runtrack focus0 Long focus coil
3. runtrack focus1 single short focus coil
4. runtrack focus2 two focus coils
5. runbeta fs2 get betas vs mom for Study 2 Lattice
6. runlong cont cool in a long Study 2 lattice
7. runring ring cool in a ring

Excercises:

1. run the three focus examples
2. make a new file from "focus1" using "new". Modify the new file to explore sensitivity to initial angles.

   Note the max radius in focus1.f01 region command and in the sheet command that sets up the field grid.

   Move the start of the coil to 0.5 m (instead of 3m)

   Increase the current so the beam is foucused near the end of z

   Add further tracks with increased the initial pt in focus.f03 till the tracks pass outside the radius limits.

   Do they all focus to the same point?
3. run "runbeta fs2"
4. make a new file using "new", then increase the two end coild currents while decreasing the single center current to obtain:

   a) betas more or less centered on 0.2 GeV/c

   b) but now with smaller betas

   Is the momentum acceptance the same?
5. run "runlong cont"
6. increase the number of particles to 2000 (on line 3 of cont.f01) and run when you have the time to wait.

7. Make a new file set and then substitute a .coi from the previous excersise that had a smaller beta.

   Is the final emittance smaller?

   Is the acceptance worse?